

# M51209P

## QUAD COMPARATOR

### DESCRIPTION

The M51209P is a quad (four independent) comparator and operates over a wide voltage range from a single supply voltage. Especially the M51209P has superiority as to characteristics of input current (input resistance) and fits to wide ranged applications, for example CR Timer, oscillator, etc.

### FEATURES

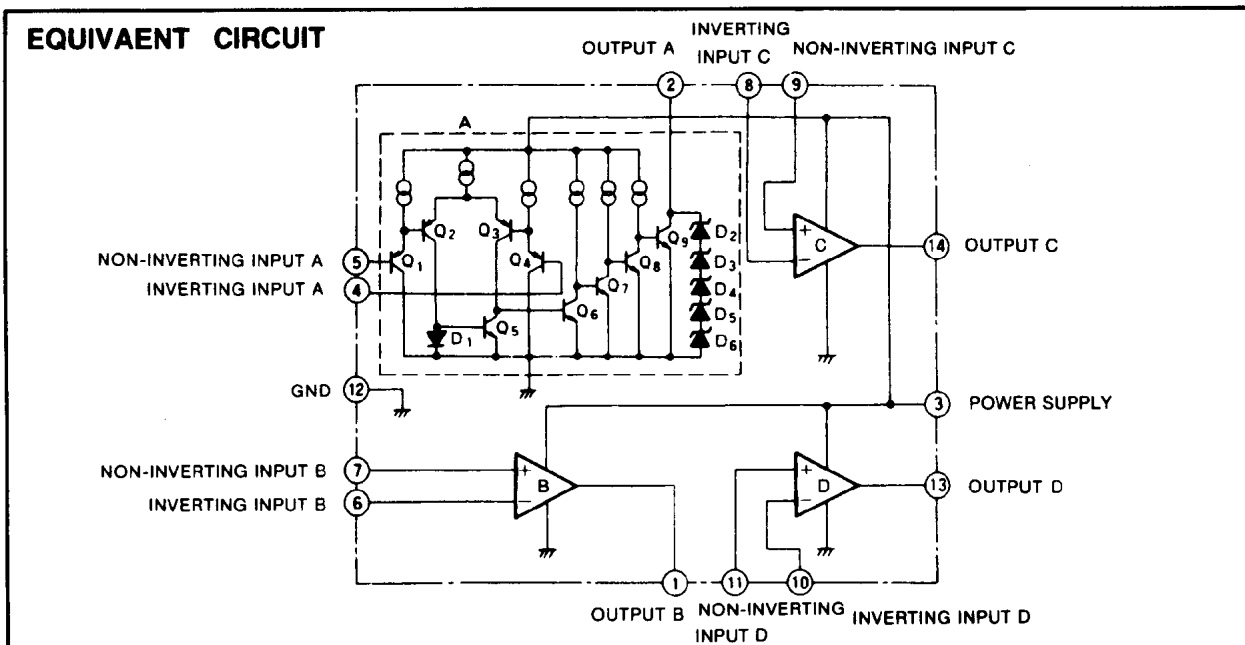
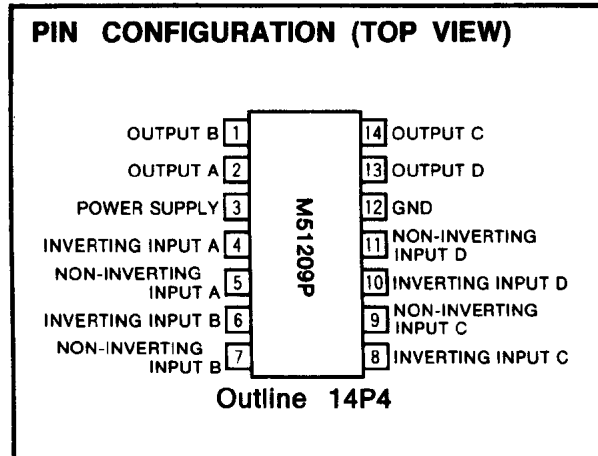
- Low input current (high input resistance) .....20nA(typ.)
- Wide supply voltage range ..... 2.5V~28V
- Low dissipation current .....6.8mA(typ.)
- Capable of driving a relay or a lamp directly  
200mA(max.)
- Includes voltage surge absorbing zener diodes
- High output breakdown voltage ..... 30V(max.)
- Low output voltage ( $I_{sink}=60mA$ ) ..... 0.2V(typ.)
- Low input offset voltage ..... 2mV(typ.)

### APPLICATION

Voltage comparator, sequential timer, pulse generator, analog / digital converter, time delay circuit

### RECOMMENDED OPERATING CONDITIONS

- Supply voltage range ..... 2.5~28V
- Rated supply voltage ..... 12V



**QUAD COMPARATOR**

**ABSOLUTE MAXIMUM RATINGS** ( $T_a=25^{\circ}\text{C}$ , unless otherwise noted)

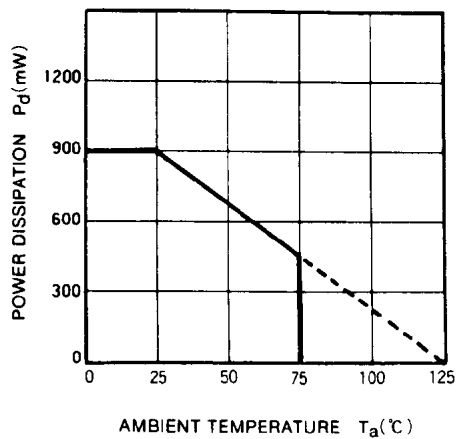
Symbol	Parameter	Conditions	Ratings	Unit
$V_{CC}$	Supply voltage		28	V
$V_{ID}$	Differential input voltage		$V_{CC}$	V
$V_{ICM}$	Common mode input voltage range		$-0.3 \sim V_{CC}$	V
$I_{sink}$	Output sink current		200	mA
$V_{OH}$	"H" output voltage		30	V
$P_d$	Power dissipation		900	mW
$T_{opr}$	Operating temperature		$-20 \sim +75$	$^{\circ}\text{C}$
$T_{stg}$	Storage temperature		$-40 \sim +125$	$^{\circ}\text{C}$

**ELECTRICAL CHARACTERISTICS** ( $T_a=25^{\circ}\text{C}$ ,  $V_{CC}=2.5 \sim 28\text{V}$ , unless otherwise noted)

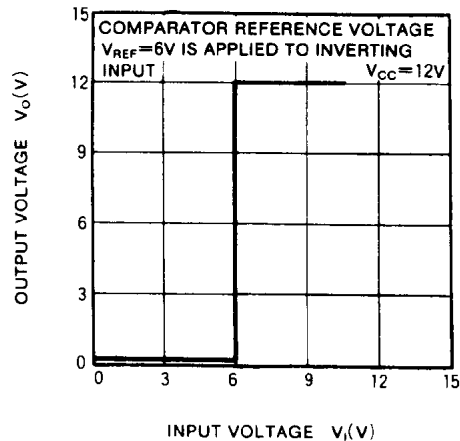
Symbol	Parameter	Test conditions	Limits			Unit
			Min	Typ	Max	
$V_{CC}$	Supply voltage range		2.5		28	V
$I_{CC}$	Circuit current			6.8	9.5	mA
$V_{IE}$	Inverting input voltage range		0		$V_{CC}-1.5$	V
$V_{IF}$	Non-inverting input voltage range		0		$V_{CC}-1.5$	V
$V_{IO}$	Input offset voltage			2	7	mV
$I_{IE}$	Inverting input current			20	100	nA
$I_{IF}$	Non-inverting input current			20	100	nA
$I_{IO}$	Input offset current			5	50	nA
$V_{OL}$	"L" output voltage	$I_{sink}=60\text{mA}$		0.2	0.6	V
		$I_{sink}=200\text{mA}$		1		
$I_{LO}$	Output leak current				0.1	$\mu\text{A}$
$t_{PLH}$	Output "L→H" propagation delay time			2		$\mu\text{s}$
$t_{PHL}$	Output "H→L" propagation delay time			1		$\mu\text{s}$

**TYPICAL CHARACTERISTICS** ( $T_a=25^{\circ}\text{C}$ , unless otherwise noted)

**THERMAL DERATING (MAXIMUM RATING)**

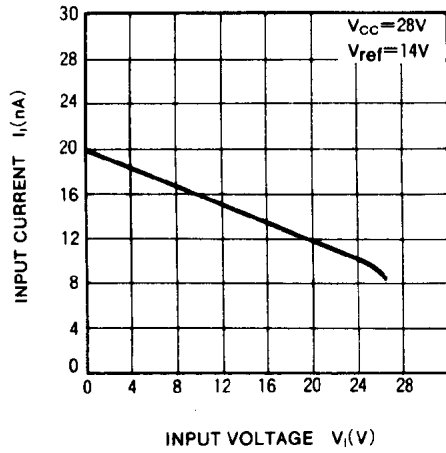


**OUTPUT VOLTAGE VS. INPUT VOLTAGE**

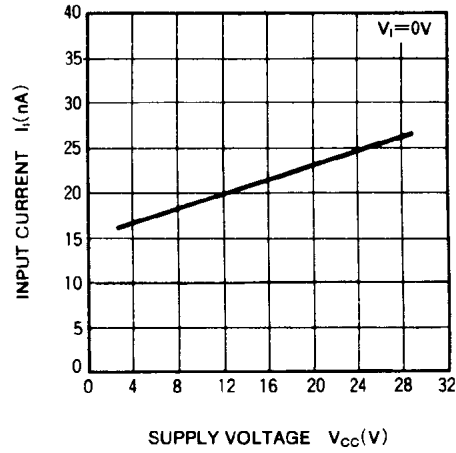


**QUAD COMPARATOR**

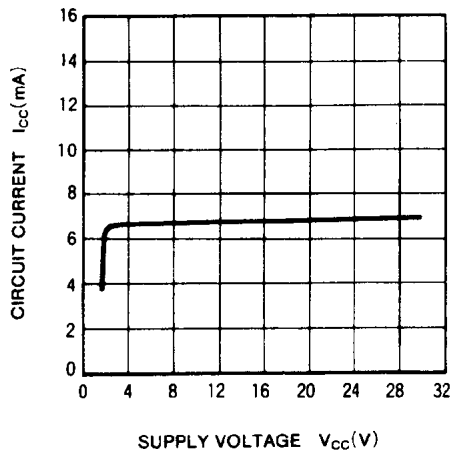
**INPUT CURRENT VS. INPUT VOLTAGE**



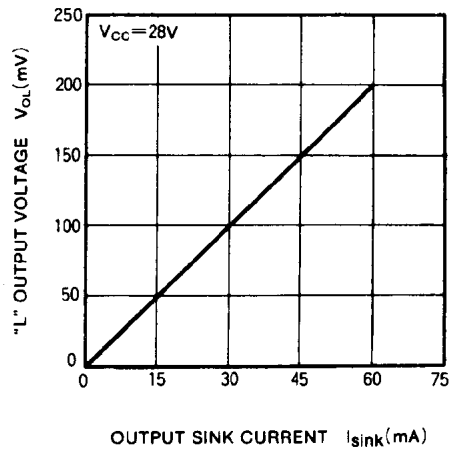
**INPUT CURRENT VS. SUPPLY VOLTAGE**



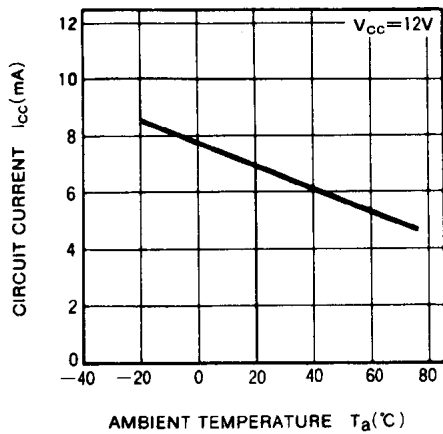
**CIRCUIT CURRENT VS. SUPPLY VOLTAGE**



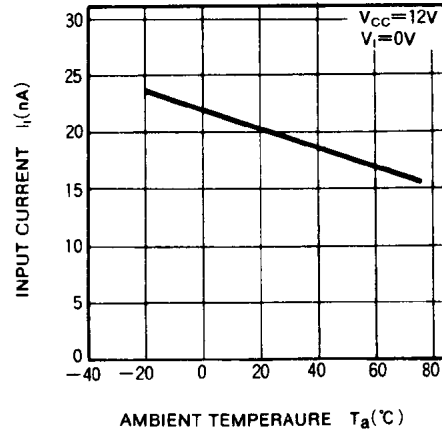
**"L" OUTPUT VOLTAGE VS. OUTPUT SINK CURRENT**



**CIRCUIT CURRENT VS. AMBIENT TEMPERATURE**



**INPUT CURRENT VS. AMBIENT TEMPERATURE**

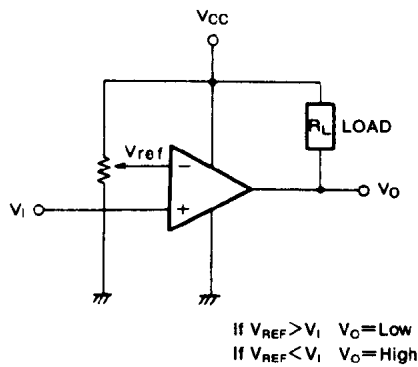


**PRECAUTIONS FOU USE**

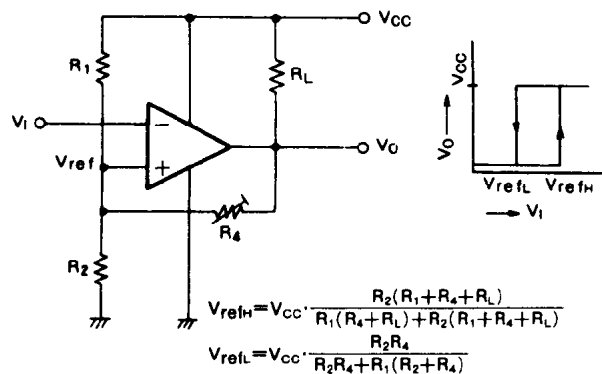
1. Special care must be taken to protect the M51209P from large surges in current, such as may result from the incorrect connection of the V<sub>CC</sub> and GND terminals.
2. Output is "open collector" and a loading resistor is not included. Connect a loading resistor to stabilize operation, when driving another.

**APPLICATION EXAMPLES**

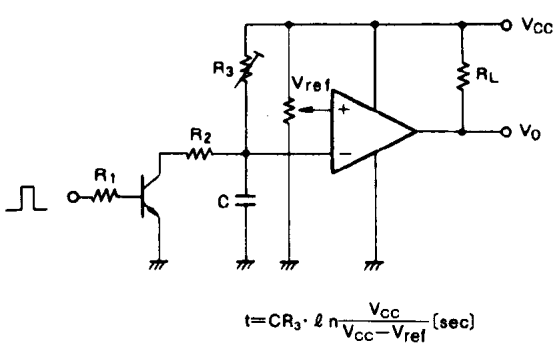
(1) Voltage comparator



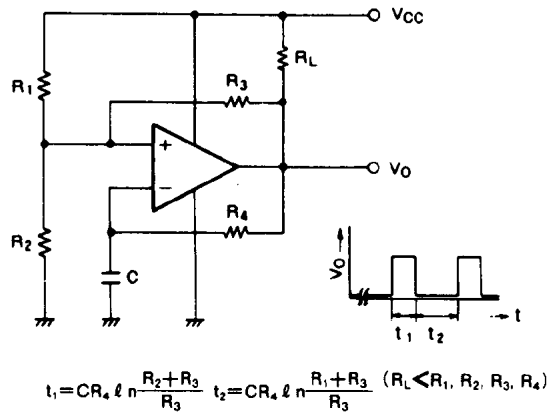
(2) Schmitt trigger circuit



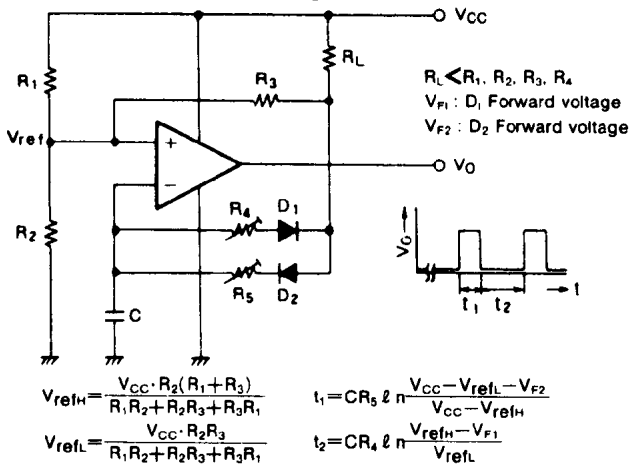
(3) Monostable multi-vibrator



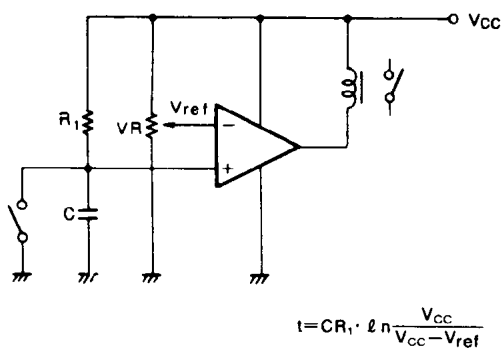
(4) Unstable multi-vibrator



(5) Pulse generator

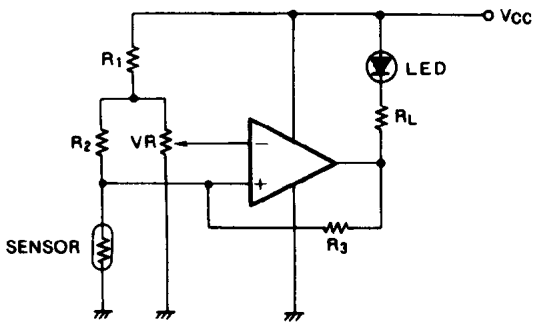


(6) CR Timer

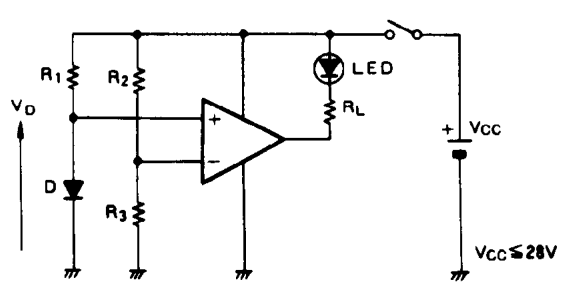


**QUAD COMPARATOR**

(7) Sensor detector



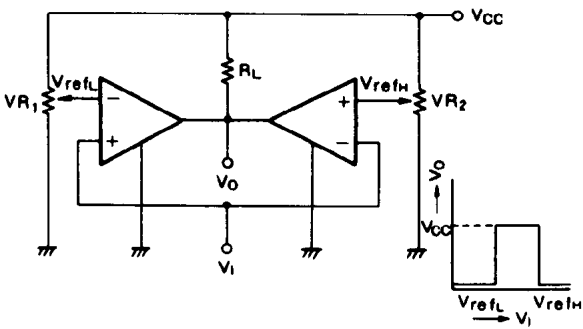
(8) Battery check circuit



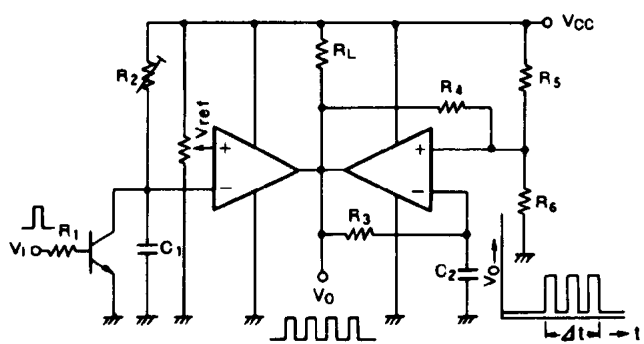
$$V_D < V_{CC} \cdot \frac{R_3}{R_2 + R_3}; \text{ LED} \rightarrow \text{ON}$$

$$V_D > V_{CC} \cdot \frac{R_3}{R_2 + R_3}; \text{ LED} \rightarrow \text{OFF}$$

(9) Window comparator

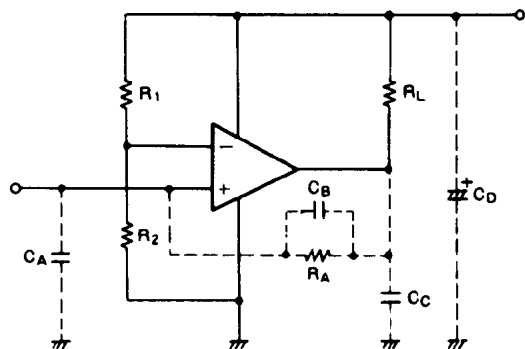


(10) Pulse train generator



$$\Delta t = C_1 R_2 \cdot \ln \frac{V_{CC}}{V_{CC} - V_{ref}}$$

(11) Countermeasure against oscillation



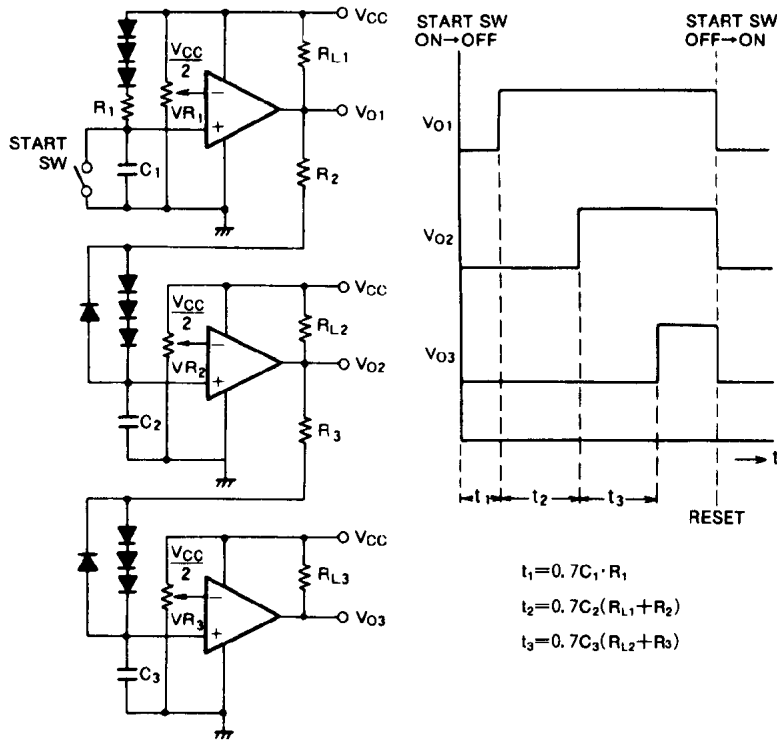
(Note) Taking steps against oscillation

The M51209P may oscillate according to input condition. If the M51209P should oscillate, the following countermeasures are applicable.

- In case of connecting input signal with chattering, connect a capacitor of small  $C_A$  value.
- In case of oscillation with ordinary input, employ positive feedback inserting  $R_A$  (large resistor),  $C_B$  (no polar) or connect  $C_C$ .
- When the supply voltage is not stabilized, connect  $C_D$  (a large electrolytic capacitor) to absorb the supply voltage change.

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(12) Sequential timer



(13) Analog/Digital converter

